

Expectation Consistency Loss

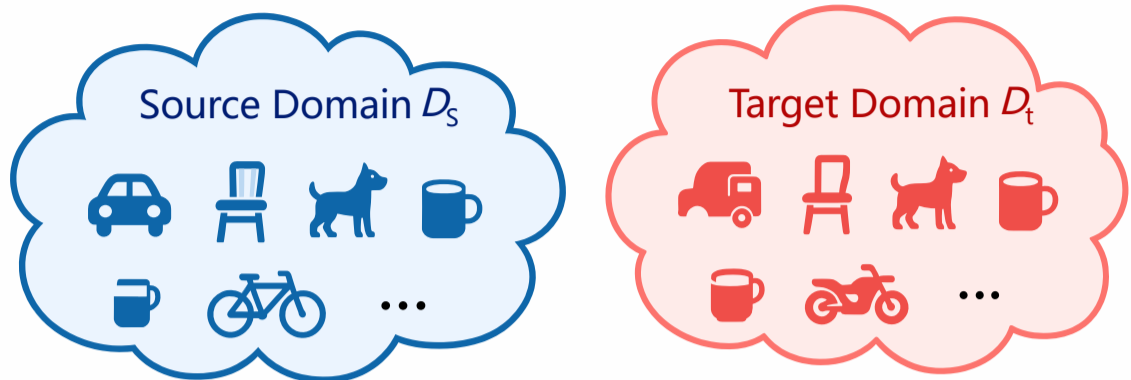
Rethink Confidence Calibration under Covariate Shift



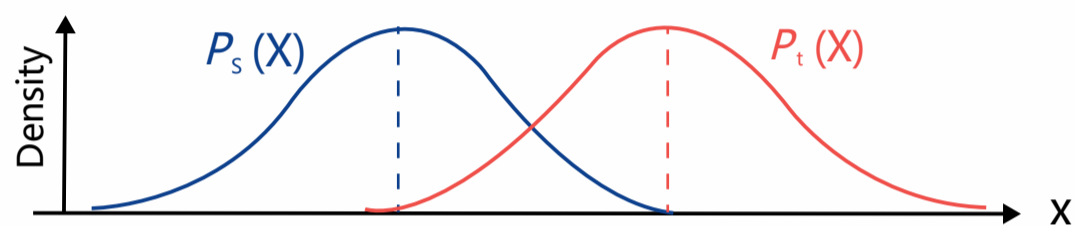
Jinzong Dong • Zhaohui Jiang • Bo Yang

Central South University

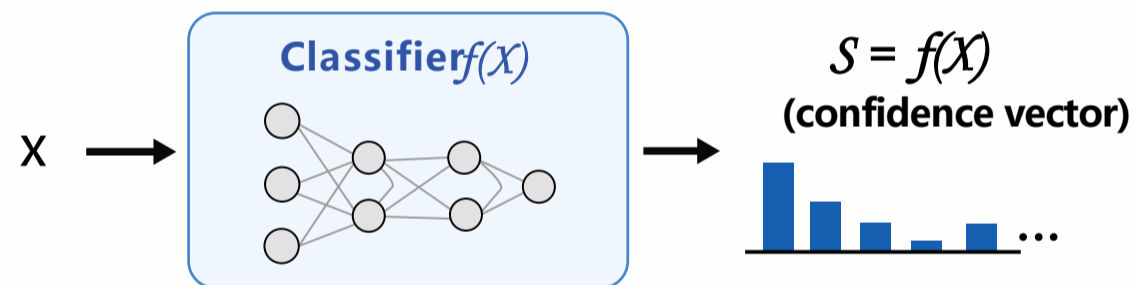
1 Covariate Shift Problem



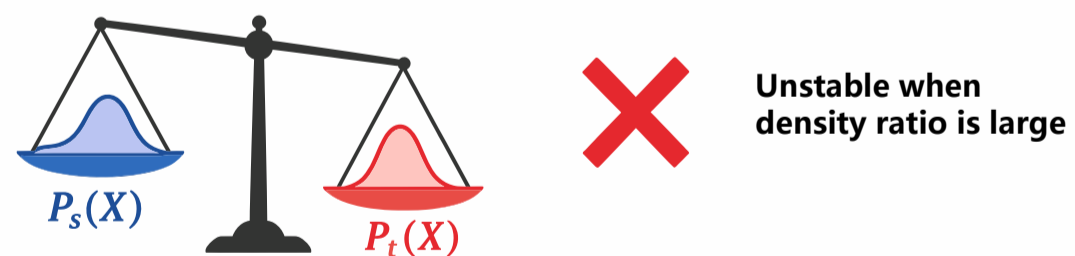
Different input distributions
 $P_s(X) \neq P_t(X)$



Same conditional label distribution
 $P_s(Y|X) \neq P_t(Y|X)$



Importance Weighting Approach



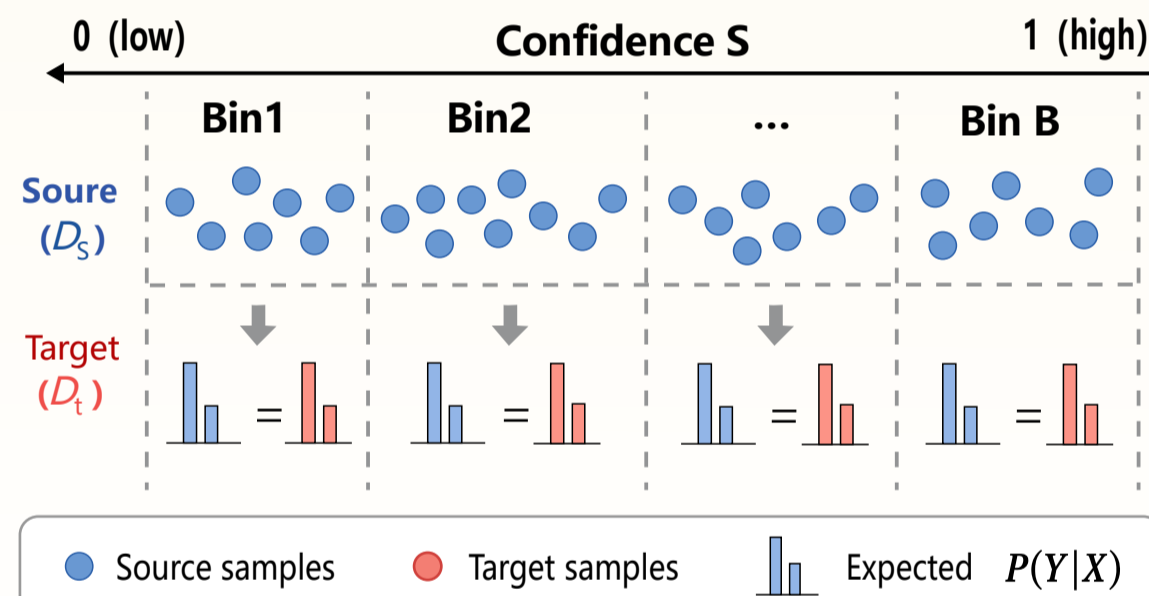
2 Key Insight: Expectation Consistency Condition

★ Global distribution alignment NOT necessary!

Weak but sufficient condition:

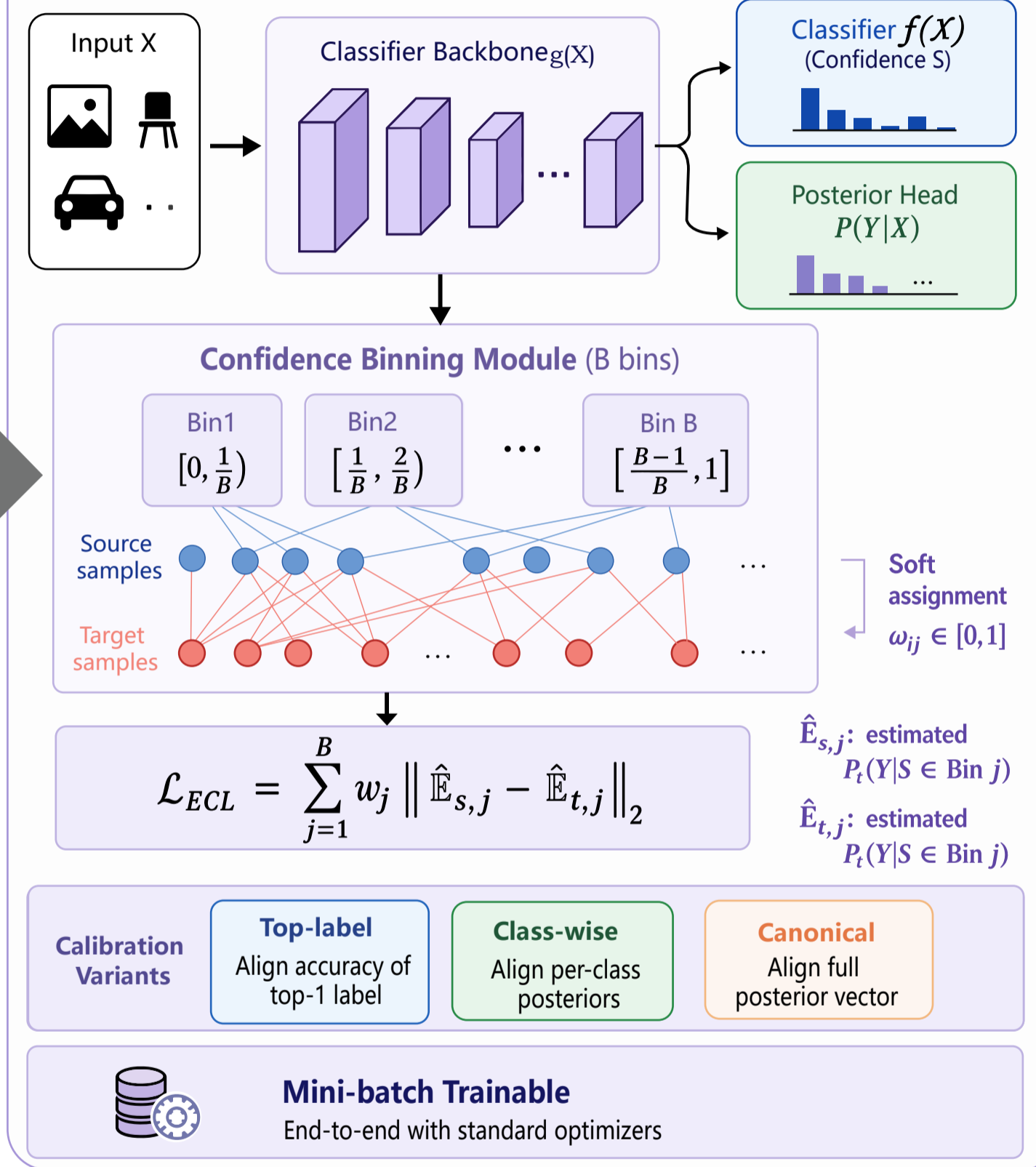
$$\mathbb{E}_{P_s(X|S)} [P(Y|X)] = \mathbb{E}_{P_t(X|S)} [P(Y|X)]$$

Align expected posteriors within each confidence level set (bin) of S.



✓ Satisfied condition \Rightarrow Calibrated on target domain

3 ECL Framework



Key Contributions

1. Necessary & sufficient condition for calibration under covariate shift
2. No importance weighting — robust to unbounded density ratios
3. Sample complexity $O(B/\epsilon^2)$, same as ECE
4. Validated on MNIST/USPS/SVHN, PACS, ImageNet-Sketch